MARKER CODE				

STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE
CHEMISTRY
2017

QUESTION and ANSWER BOOKLET

Time allowed: 3 Hours

INSTRUCTIONS

1. Write your **Student Enrolment Number (SEN)** on the top right-hand corner of this booklet.
2. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
3. If you need more space for answers, ask the Supervisor for extra paper. Write your SEN on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.

QUESTIONS AND TOPICS		Pages	Time (mins)	Total
QUESTION 1	ATOMIC STRUCTURE & BONDING	2-3	16	13
QUESTION 2	ENERGETICS OF CHEMICAL AND PHYSICAL PROCESSES	4-6	16	14
QUESTION 3	EQUILIBRIUM	7-10	16	21
QUESTION 4	OXIDATION - REDUCTION	11-12	16	6
QUESTION 5	ORGANIC CHEMISTRY	13-15	16	21
TOTAL		**15**	**120**	**75**

.

Check that this booklet contains pages 2-15 in the correct order.

Show all working. Periodic table are given on Sheet 1 provided.

YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

QUESTION 1: ATOMIC STRUCTURE & BONDING

a. i. Arrange the atoms of B, C, O, and Be in terms of increasing 1st ionization enthalpy and increasing electronegativity.

Skill level 2	
2	
1	
0	
NR	

ii. Explain the reasons behind the increasing 1st Ionization enthalpy and increasing electronegativity of the elements B, C, O and Be.

Skill level 3	
3	
2	
1	
0	
NR	

b. Determine the polarity of the molecule of Boron Trifluoride. Given that the Electronegativity (EN) of Boron EN = 2.0 and Fluorine EN = 4.0.

Skill level 2	
2	
1	
0	
NR	

c. Predict which substance will have the higher boiling point, ammonia (NH_3) or neon (Ne). Explain in terms of the intermolecular forces.

Skill level 4	
4	
3	
2	
1	
0	
NR	

d. Name particle ***X*** in the following nuclear transformation equation.

$$^{211}_{84}Po \longrightarrow {}^{207}_{82}Pb + X$$

Skill level 1	
1	
0	
NR	

e. Write the ground state electron configuration of Sc^+ using s,p,d and f notation.

Skill level 1	
1	
0	
NR	

QUESTION 2: ENERGETICS OF CHEMICAL AND PHYSICAL PROCESSES

a. Define the following terms:

i. $\Delta_{vap}H°$

Skill level 1	
1	
0	
NR	

ii. $\Delta_{fus}H°$

Skill level 1	
1	
0	
NR	

b. Copper (I) oxide can be oxidized to copper (II) oxide.

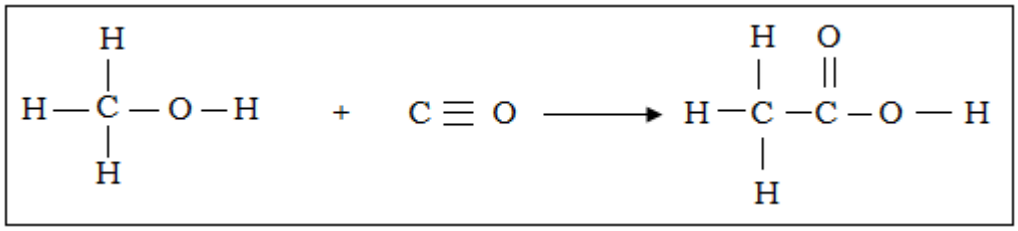
$Cu_2O_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow 2CuO_{(s)}$ ΔH°_{rxn} = -146.0 KJ

Given ΔH°_{f} of $Cu_2O_{(s)}$ = -168.6 KJ/mol.

Calculate the ΔH°_{f} of CuO (s)

Skill level 2	
2	
1	
0	
NR	

c. The reaction of methanol with carbon monoxide is an important industrial route to extremely pure acetic acid as shown below.



Predict whether the reaction is exothermic or endothermic by calculating the enthalpy change of reaction using the given average bond enthalpies.

Average Bond Enthalpies in KJ/moles:

C-H = 413, C-O = 358, O-H = 467, C=O = 745, C – C = 347, C ≡ O = 1070

Skill level 4	
4	
3	
2	
1	
0	
NR	

d. Explain any three sustainable water management practices that could be used to maintain water production for farmers especially when there will be a lot of droughts in Tonga.

Skill level 3	
3	
2	
1	
0	
NR	

e. Explain any three waste management practices here in Tonga that can be used to maintain sustainable production of plastic.

_____

_____

_____

_____

_____

_____

_____

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 3: EQUILIBRIUM

a. If the conditions in a certain reaction changes and the rate of the forward reaction increases more than that of the reverse reaction. Explain what is the effect on the reaction equilibrium constant and on the concentrations of the reactants and products at equilibrium.

Skill level 3	
3	
2	
1	
0	
NR	

b. In an experiment to study the formation of $HI_{(g)}$, $H_{2\,(g)}$ and $I_{2\,(g)}$ were placed in a closed container at a certain temperature as shown in the equation below.

$$I_{2\,(g)} + H_{2\,(g)} \rightleftharpoons 2HI_{(g)}$$

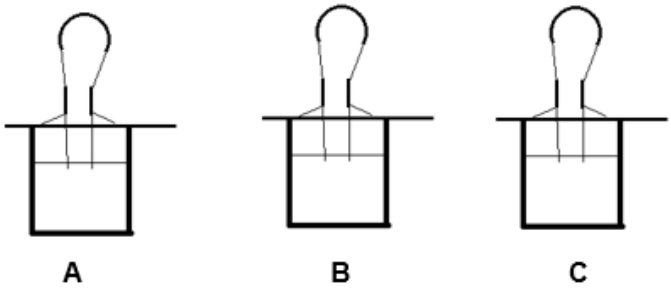
At equilibrium: $[H_2] = 5.5 \times 10^{-5}$M, $[I_2] = 1.05 \times 10^{-3}$ M and $[HI] = 1.80 \times 10^{-3}$ M

Calculate equilibrium constant, K_c for the reaction at this temperature.

Skill level 2	
2	
1	
0	
NR	

c. The following diagrams indicate solutions of LiOH, CH_2CH_2 and NH_3 in water. Each solution is connected to a light bulb.

As a result, light bulb at solution **A** shines brightly, solution **B** has no light while light bulb at solution **C** gives a dim light as shown below.



A	B	C
Shine brightly	**No light**	**Dim light**

Match the chemical solutions, LiOH, CH_2CH_2 and NH_3 to beakers A, B and C then use equations to explain why the light bulbs behave as they do.

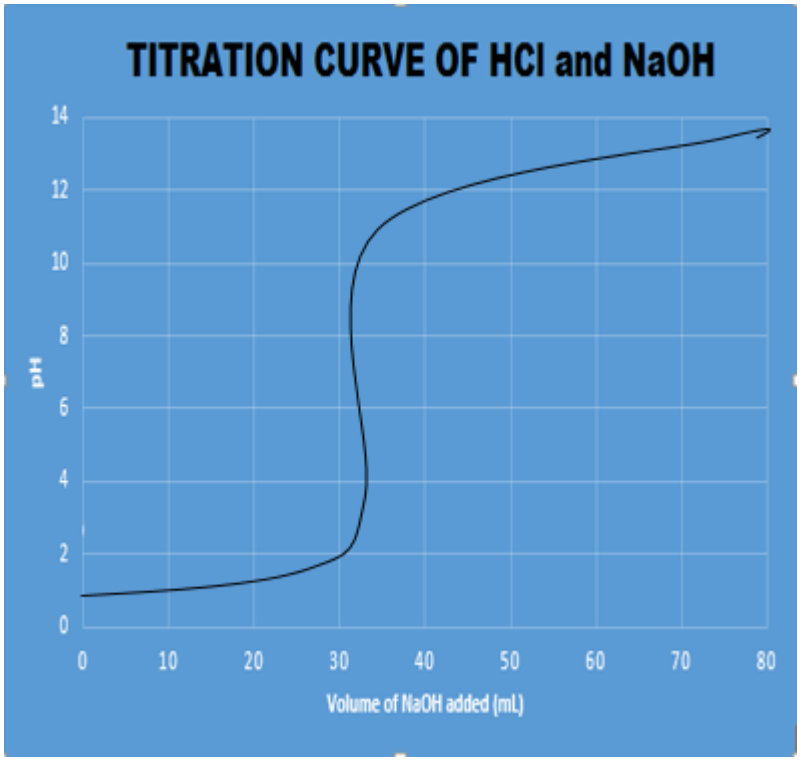
Skill level 3	
3	
2	
1	
0	
NR	

d. Hydrofluoric acid (HF) is a weak acid which does not completely ionize in water. The acid dissociation equilibrium constant, K_a of HF is 7.1×10^{-4} at 25 ^{o}C.

Determine the relative concentration of all species (HF, H^+, and F^-) present at equilibrium if the initial concentration of HF solution is 0.80 M.

Skill level 2	
2	
1	
0	
NR	

e. In a particular titration, 40mL of 0.10 M HCl was titrated with 0.10 M of NaOH and the results were plotted as shown in the following titration curve.



i. Calculate the pH of the solution after adding 20mL of NaOH.

Skill level 3	
3	
2	
1	
0	
NR	

ii. State the pH value of the solution at the equivalence point.

Skill level 1	
1	
0	
NR	

f. Slaked lime or Calcium Hydroxide is a large component of plaster, mortar and cement and solutions of $Ca(OH)_2$ are used in the industries as a cheap yet strong base.

Calculate the molar solubility of $Ca(OH)_2$ in water if $K_{sp} = 6.0 \times 10^{-6}$.

Skill level 3	
3	
2	
1	
0	
NR	

g. Predict whether the solubility of the salts, AgCl and $CaCO_3$ is affected by pH. In your discussion, you must include the followings;

i. equation for the dissociation of each salt
ii. ability of the ions to hydrolyze (react with water)
iii. equation for the hydrolysis of ions (if any)
iv. effect of pH change on the solubility of the salt

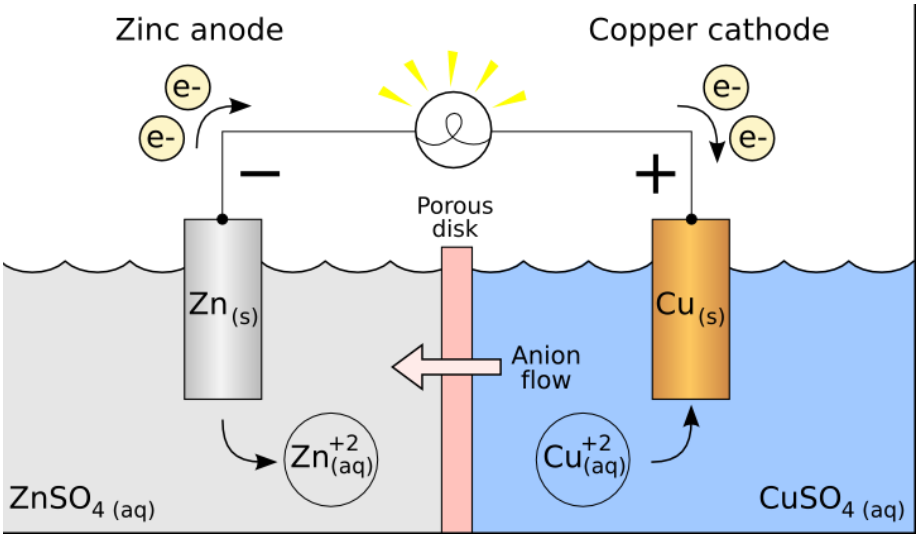
Skill level 4	
4	
3	
2	
1	
0	
NR	

Question 4: OXIDATION - REDUCTION

a. Describe the features of oxidation - reduction reactions.

Skill level 2	
2	
1	
0	
NR	

b. The following diagram is a galvanic cell. Use it to answer the following questions.



https://en.wikipedia.org/wiki/Galvanic_cell

Skill level 1	
1	
0	
NR	

i. Name the species that is being oxidized in the above cell.

Skill level 1	
1	
0	
NR	

ii. Name the oxidizing agent in the above cell.

iii. Represent the overall reaction using the correct cell notation (IUPAC Notation).

Skill level 2	
2	
1	
0	
NR	

_____

QUESTION 5: ORGANIC CHEMISTRY

a. Draw the structure of 2-methylbutan-2-one.

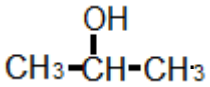
Skill level 2	
2	
1	
0	
NR	

b. i. Draw any two constitutional isomers of the ***ester*** molecule with the molecular formula of $C_5H_{10}O_2$.

Skill level 2	
2	
1	
0	
NR	

ii. Use IUPAC rules to name the two isomers identified in question b.i

Skill level 2	
2	
1	
0	
NR	

c. An additive in Hand sanitising solutions use 2-propanol, 
Describe the oxidation reaction of 2-propanol with Cr_2O_7/H^+ by writing the chemical equation for the reaction involved.

Skill level 2	
2	
1	
0	
NR	

d. Describe the reaction of chloro-ethane (or ethyl chloride) with water by writing the chemical equation.

Skill level 2	
2	
1	
0	
NR	

e. Describe the reaction of ethyl amine with water in terms of how ethyl amine act in the reaction and confirming your description with the chemical reaction.

Skill level 2	
2	
1	
0	
NR	

f. Explain how the structure of $CH_3CHBrCH_3$ determines the two types of reactions it is involved in, giving examples in each case.

Skill level 3	
3	
2	
1	
0	
NR	

g. A lot of Polymers are electrical insulators and some are transparent. Explain how polymers have these properties in relation to their structure and bonding, giving an example in each case.

Skill level 3	
3	
2	
1	
0	
NR	

h. An unknown organic liquid with a pungent unpleasant smell but it is miscible in water. A concentrated sodium hydroxide solution was added to it and it became soluble. When ethanol and concentrated sulphuric acid were added to this white liquid they produced a sweet smelling odour. The same liquid has an effervescence reaction with sodium carbonate releasing a gas that turns lime -water milky.

Identify the unknown organic liquid then write its chemical reaction with **either** ethanol or with sodium carbonate.

Skill level 3	
3	
2	
1	
0	
NR	